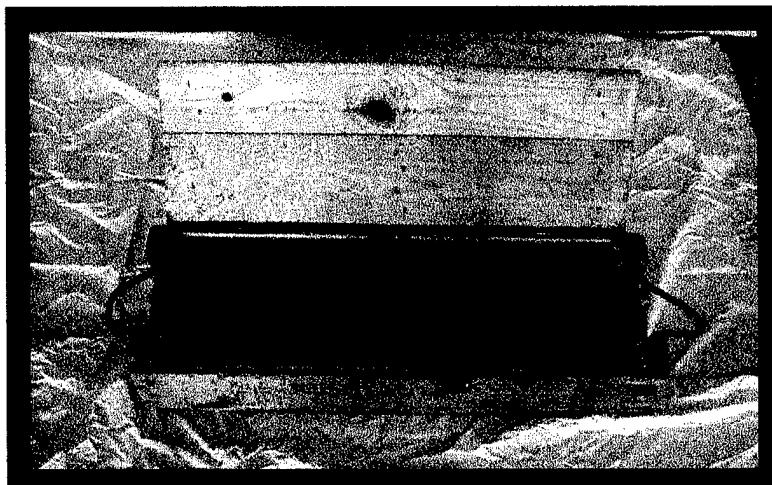


**FINAL REPORT
JANUARY 2002**

REPORT NO. 02-04

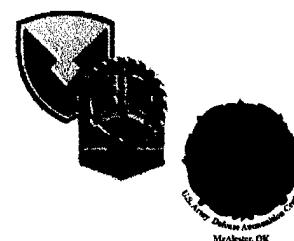


**BOX, WOODEN FOR 105MM HOWITZER
AMMUNITION IN A FIBER CONTAINER, M105A3,
UNITED NATIONS (UN) PERFORMANCE ORIENTED
PACKAGING (POP) TEST**

Distribution Unlimited

Prepared For:

McAlester Army Ammunition Plant
McAlester, OK 74501



**VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053**

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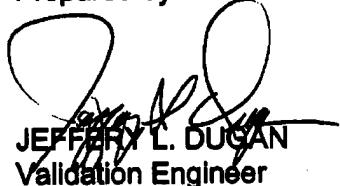
**TEST REPORT NO. 02-04
BOX, WOODEN FOR 105MM HOWITZER
AMMUNITION IN A FIBER CONTAINER, M105A3,
UNITED NATIONS (UN) PERFORMANCE ORIENTED
PACKAGING (POP) TEST**

JANUARY 2002

ABSTRACT

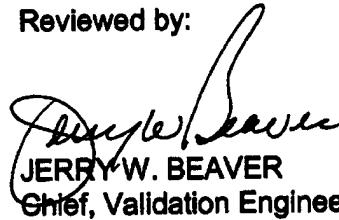
The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by the McAlester Army Ammunition Plant (MCAAP) to conduct a UN POP Test for box, wooden for 105mm Howitzer ammunition in a fiber container, M105A3. Six test sample boxes were used in the tests. No significant flaws were found. As a result of the performance of the containers during testing, the box, wooden for 105mm Howitzer ammunition in a fiber container, M105A3 is recommended for USA-wide use.

Prepared by:



JEFFERY L. DUGAN
Validation Engineer

Reviewed by:



JERRY W. BEAVER
Chief, Validation Engineering Division

U.S. ARMY DEFENSE AMMUNITION CENTER

**VALIDATION ENGINEERING DIVISION
MCALESTER, OK 74501-9053**

REPORT NO. 02-04

**BOX, WOODEN FOR 105MM HOWITZER
AMMUNITION IN A FIBER CONTAINER, M105A3,
UNITED NATIONS (UN) PERFORMANCE ORIENTED
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PART 1 – INTRODUCTION

- A. **BACKGROUND.** The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by the McAlester Army Ammunition (MCAAP) to conduct a UN POP Test for certification of the box, wooden for 105mm Howitzer ammunition in a fiber container, M105A3.
- B. **AUTHORITY.** This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (OSC), Rock Island, IL. Effective 9 July 1993, the three-letter designator “DEV” was assigned for use when conducting UN POP tests. Effective 9 August 1994 this designation was included in the Joint Regulation AR 700-143, Performance Oriented Packaging of Hazardous Materials. Reference is made to the following:
- IOC-R, 10-23, Mission and Major Functions of USADAC,
7 January 1998.
- C. **OBJECTIVE.** To determine if this item meets UN POP requirements.
- D. **CONCLUSION.** As tested, the box, wooden for 105mm Howitzer ammunition in a fiber container, M105A3 meets all UN POP requirements with no problems encountered during testing.

PART 2 – ATTENDEES

DATE PERFORMED: 30 October – 2 November 2001

ATTENDEE

Jeffery L. Dugan
General Engineer
DSN 956-8090
(918) 420-8090

Daryl K. Sieczkowski
Electronics Technician
DSN 956-8988
(918) 420-8988

MAILING ADDRESS

Director
U.S. Army Defense Ammunition Center
ATTN: SOSAC-DEV
1 C Tree Road, Bldg. 35
McAlester, OK 74501-9053

Director
U.S. Army Defense Ammunition Center
ATTN: SOSAC-DEV
1 C Tree Road, Bldg. 35
McAlester, OK 74501-9053

PART 3 -TEST PROCEDURES

The test procedures outlined herein were extracted and summarized from 49 CFR, Subpart M, Section 178.600. All tests were conducted to Packing Group II requirements.

A. DROP TEST. Each package will be dropped onto a non-yielding surface from the height and orientations listed below. The drop height is measured as the vertical distance from the target to the lowest point on the package. The drop height for Packing Group I is 1.8 meters (5.9 feet), for Packing Group II it is 1.2 meters (3.9 feet), and Packing Group III is 0.8 meters (2.6 feet) for materials which have a specific gravity (SG) exceeding 1.2, the drop height must be calculated as follows: for Packaging Group I the SG X 4.9 feet; for Packaging Group II the SG X 3.3 feet; and, for Packaging Group III the SG X 2.2 feet.

Packaging	No. of Tests	Drop Orientation of Samples
Steel drums, Aluminum drums, Metal Drums (other than steel or aluminum), Steel jerricans, Plywood drums, Wooden barrels, Fiber drums, Plastic drums and jerricans, Composite packagings which are in the shape of a drum	Six ... (three for each drop)	First drop (using three samples): The package must strike the target diagonally on the chime or, if the packaging has no chime, on the circumferential seam or an edge. Second drop (using the other three samples): The package must strike the target on the weakest part not tested by the first drop, for example a closure or, for some cylindrical drums, the welded longitudinal seam of the drum body.
Boxes of natural wood, Plywood boxes, Reconstituted wood boxes, Fiberboard boxes, Plastic boxes, Steel or aluminum boxes, Composite packagings which are in the shape of a box.	Five... (one for each drop)	First drop: Flat on the bottom (using the first sample). Second drop: Flat on the top (using the second sample). Third drop: Flat on the long side (using the third sample). Fourth drop: Flat on the short side (using the fourth sample). Fifth drop: On a corner (using the fifth sample).
Bags --- single-ply with a side seam	Three... (three drops per bag).	First drop: Flat on a wide face (using all three samples). Second drop: Flat on a narrow face (using all three samples). Third drop: On an end of the bag (using all three samples).
Bags --- single-ply without a side seam, or multi-ply	Three... (three drops per bag).	First drop: Flat on a wide face (using all three samples). Second drop: On an end of the bag (using all three samples).

B. LEAKPROOFNESS TEST. Three samples of each different packaging must be tested and pass the leakproofness test. The packaging must be restrained under water while the internal air pressure is applied. An internal air pressure must be applied to the packaging as indicated for the following groups;

- (1) Packaging Group I: Not less than 30 kPa (4 psi)
- (2) Packaging Group II: Not less than 20 kPa (3 psi)
- (3) Packaging Group III: Not less than 20 kPa (3 psi)

The test must be conducted for a minimum time of 5 minutes.

C. HYDROSTATIC PRESSURE TEST. Three test samples are required for each different packaging. For packagings constructed of stainless steel, monel, or nickel, only one sample is required for periodic retesting of packagings. Metal packagings and composite packagings other than plastic, including their closures, must be subjected to the test for 5 minutes. Plastic packagings and composite packagings, including their closures, must be subjected to the test pressure for 30 minutes. The test pressure must be applied continuously and evenly, and it must be keep constant throughout the test period. The hydraulic pressure applied, taken at the top of the receptacle, and determined by any one of the following methods must be:

- (1) Not less than the total gauge pressure measured in the packaging at 55 degrees C (131 degrees F), multiplied by a safety factor of 1.5. This total gauge pressure must be determined on the basis of a maximum degree of filling with a filling temperature of 15 degree C (59 degree F);
- (2) Not less than 1.75 times the vapor pressure at 55 degrees C (122 degrees F) of the material to be transported minus 100 kPa (15 psi), but with a minimum test pressure of 100 kPa (15 psi); or
- (3) Not less than 1.5 times the vapor pressure at 55 degrees C (131 degrees F) of the material to be transported minus 100 kPa (15 psi), but with a minimum test pressure of 100 kPa (15 psi).

Packagings intended to contain hazardous materials of Packing Group I must be tested to a minimum test pressure of 250 kPa (36 psi).

D. **STACKING TEST.** Three test samples must be subjected to a force applied to the top surface of the test sample equivalent to the total weight of identical packages that might be stacked on it during transport. The minimum height of the stack, including the test sample, must be 3.0 meters (10 feet). The duration of the test must be 24 hours, except that plastic drums, jerricans, and composite packaging 6HH, intended for liquids, shall be subjected to the stacking test for a period of 28 days at a temperature of not less than 40 degrees Celsius (104 degrees Fahrenheit). Alternative test methods that yield equivalent results may be used if approved by the Associate Administrator for Hazardous Materials Safety.

E. **VIBRATION TEST.** Three sample packagings, selected at random, must be filled and closed as for shipment. The three samples must be placed on a vibrating platform that has a vertical or rotary double-amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform, but must be left free to move vertically, bounce and rotate. The test must be performed for one hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material approximately 1.6mm (0.063 inch) thickness (such as steel strapping or paperboard) can be passed between the bottom of any package and the platform.

F. **PASS/FAIL CRITERIA.** A package passes the above tests if there is no rupture or leakage from any of the samples. No test sample should show any deformation that could adversely affect transportation safety or any distortion liable to reduce packaging strength.

PART 4 – TEST RESULTS

UN POP tests for certification of the box, wooden for 105mm Howitzer ammunition in a fiber container, M105A3 were conducted on the boxes with part number 7549072. Applicable tests conducted were as follows:

A. **DROP TEST.** Drop tests were conducted on 31 October 2001 from 3.9 feet on test samples 2, 3, and 4. The impact surface was a steel sheet covering a concrete surface that provided an unyielding surface. The drops conducted were oriented flat-bottom, flat-top, flat-long side, flat-short side, and corner. Post drop inspections showed no significant damage. Photo 1 shows the setup used for the drop tests.

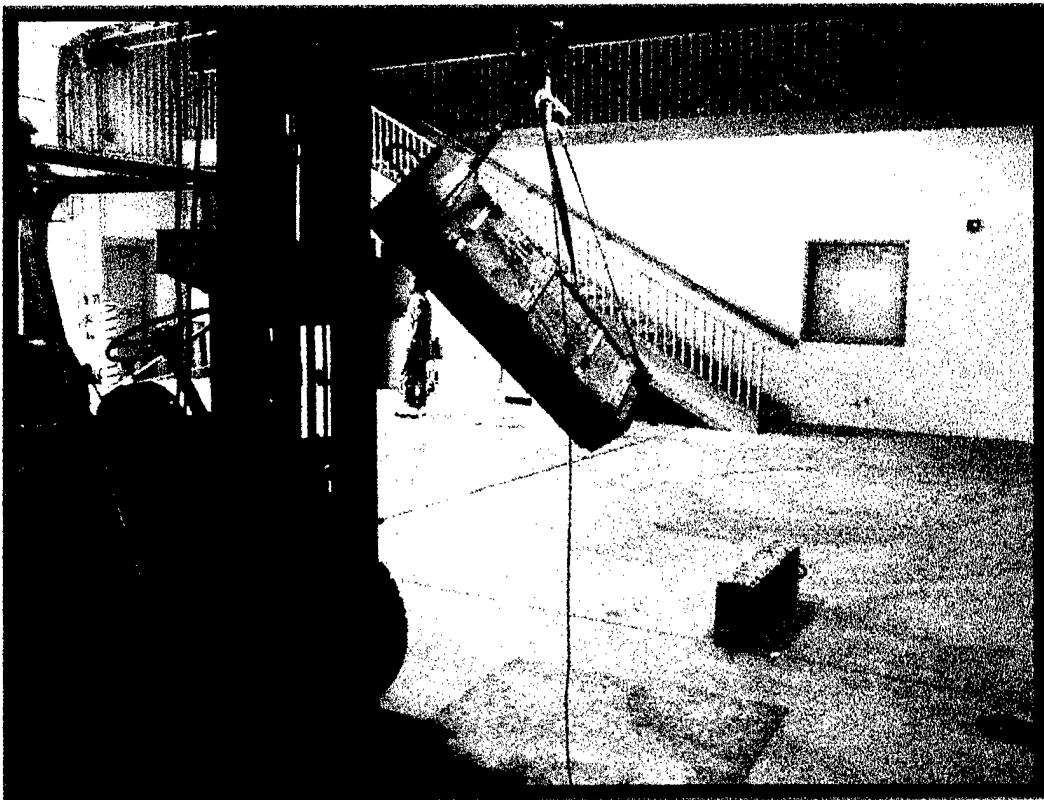


Photo 1. Drop Test Setup for UN POP Testing

B. COMPRESSION TEST. The compression test was conducted on 31 October to 1 November on test sample 1 and from 1 November to 2 November on test samples 5 and 6. The test compression was for 24 hours. The compression weight was 2,200 pounds. This weight equates to a minimum stack height of 10 feet as required by UN POP test procedures. End of test inspection indicated no damage. See Photo 2 for test setup for compression tests.

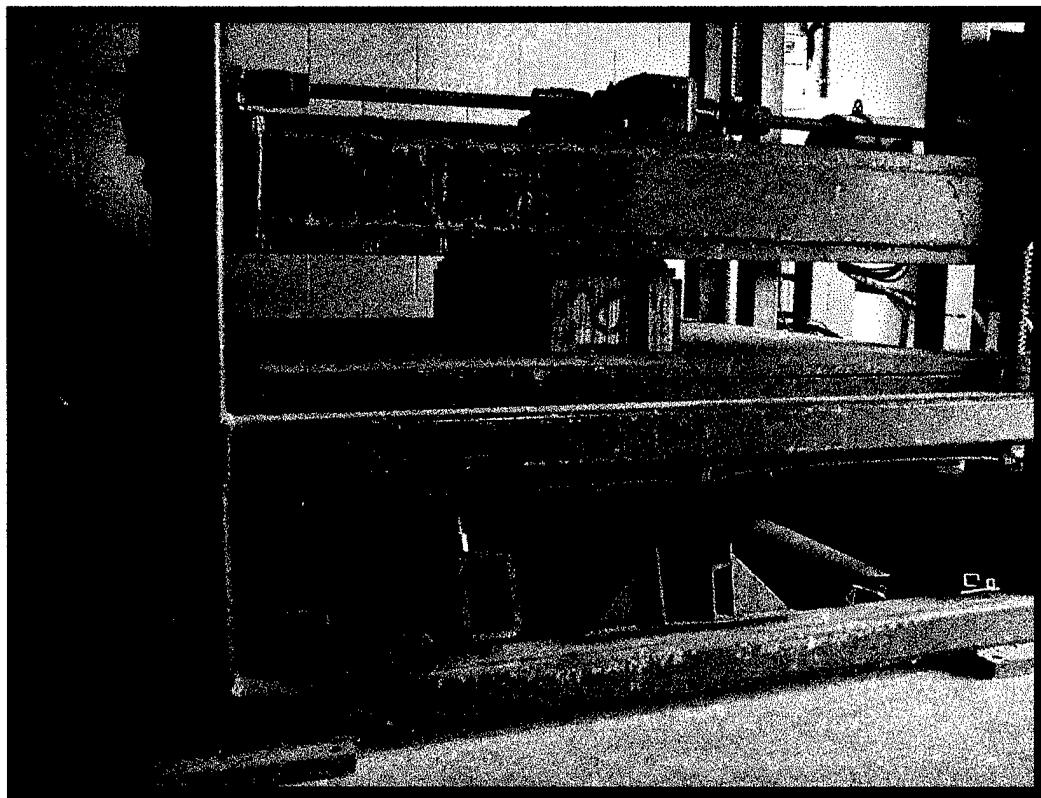


Photo 2. Compression Test Setup for UN POP Testing

C. VIBRATION TEST - The vibration tests were conducted on 31 October 2001 on test samples 2, 3, and 4. The test ran for 1 hour for each test sample in the lateral and longitudinal directions. The test samples were vibrated at 234

rpm in the lateral direction and 266 rpm in the longitudinal direction. Post vibration test inspections showed no significant damage. Photo 3 shows the setup for the vibration tests.

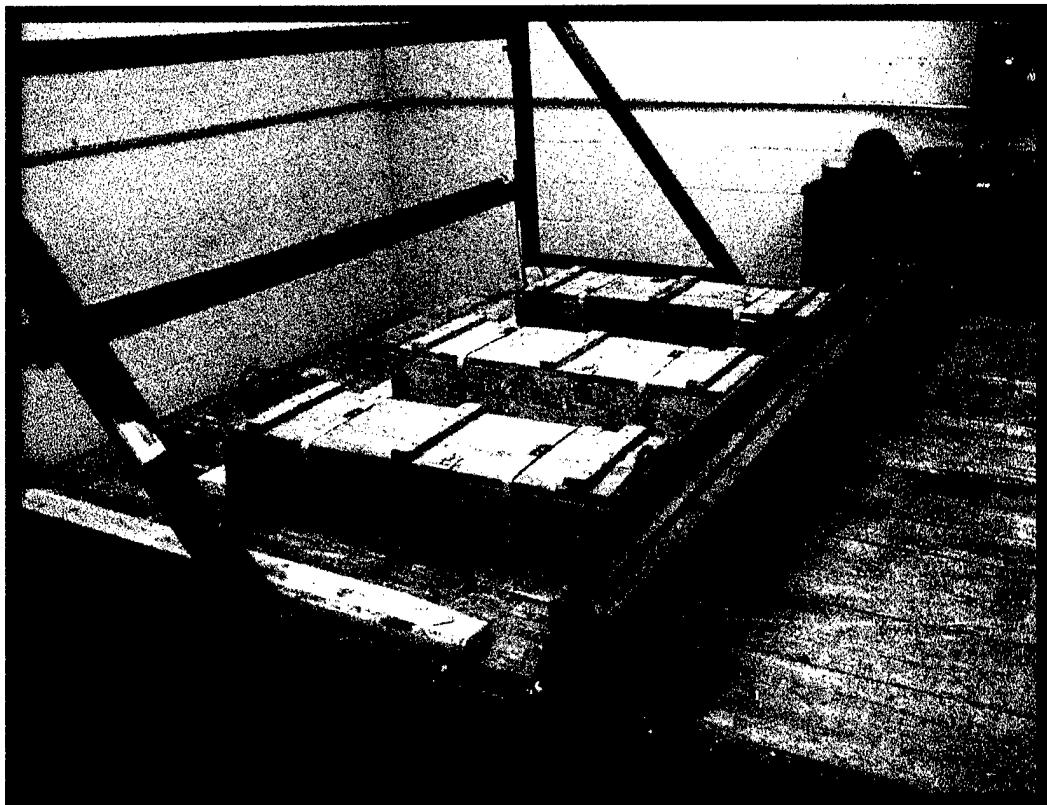


Photo 3. Vibration Test Setup for UN POP Testing

UN POP TESTS (STANDARD FORM)

**BOX, WOODEN FOR 105MM HOWITZER
AMMUNITION IN A FIBER CONTAINER, M105A3,
UNITED NATIONS (UN) PERFORMANCE ORIENTED
PACKAGING (POP) TEST**

**U.S. Army Defense Ammunition Center
ATTN: SOSAC-DEV, 1 C Tree Road
McAlester, OK 74501-9053**

918-420-8908

Jerry W. Beaver

Test Report Number: 02-04	Service Code: DEV
Product NSN: **	Nomenclature: Cartridge, 105mm
	HE M1 W/O Fuze
Shipping Name: Cartridges for Weapons	UN ID Number: **
Hazard Class: **	Packaging Group: II
Physical State: Solid	NALC/DODAC: **
CAA Number: N/A	EX Number: **
CFR 49 Packaging Method: 130	
Net Explosive Weight: **	

**** For this information see the Joint Hazard Classification System for the item to be shipped.**

DESCRIPTION OF PACKAGINGS TO BE TESTED
EXTERIOR CONTAINER

Exterior Container: Box, Wooden

CFR 49 Reference Number: 178.513

UN Code: 4C1

NSN Exterior Container:

Specifications: 4C1

Net Quantity Weight: 145.5 lbs. (66 kg)

Tested Gross Weight: 145.5 lbs. (66 kg)

Dimensions Interior: 32 X 10.375 X 5.25

Manufacturer: Unknown

Year Container Manufactured: 1966

Drawing Number(s): 7549072

Cushioning: None

Closure: ¾" steel banding

INTERMEDIATE CONTAINER

Intermediate Container Description: N/A

Specification Number: N/A

Container NSN: N/A

Intermediate Container Cushioning: N/A

Intermediate Container Closure Method: N/A

Intermediate Container Dimensions: N/A

Number Of Intermediate Containers: N/A

UNIT CONTAINER

Unit Container Description: Fiber Tube

Unit Container Specification: MIL-C-2439, Drawing 7549073

Unit Container NSN: N/A

Unit Container Cushioning: N/A

Unit Container Closure Method: Tape, nylon

Unit Container Dimensions: 5.156 DIA. X 31.875 L

Number of Unit Containers: 2

SPECIAL NOTES

All exterior, intermediate, and unit containers must be inspected prior to use.

Inspect for physical damage, structural integrity and leakproofness of the containers.

SUPPLEMENTAL INFORMATION

Permitted Transportation Modes:

Military or DOD licensed truck, rail, and ship.

Military or DOD licensed aircraft.

Specific Gravity: N/A

Hydrostatic Test Pressure Applied: N/A

Leakproofness Test Applied: N/A

TEST PROCEDURES

Test Conducted	Test Method	Test Results
(1) Pre-Conditioning (fiberboard)	Part 178.602	N/A
(2) Drop Test	Part 178.603(e)(1)(ii)	Pass
(3) Leakproofness Test	Part 178.604	N/A
(4) Hydrostatic Pressure Test	Part 178.605	N/A
(5) Stacking Test (500 lbs.)	Part 178.606(c)(1)	Pass
(6) Vibration Test	Part 178.608(b)(3)	Pass

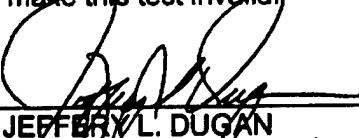
UN POP Marking

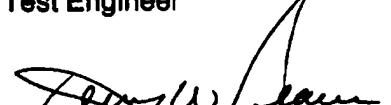
u 4C1/Y66/S/01

n USA/DOD/DEV

CERTIFICATION

Unless expressly stated to the contrary, we certify that all of the above applicable tests have been performed in strict conformance to CFR 49, Subpart M, Parts 178.600 – 178.608. Based on the successful test results shown above, this container is deemed suitable for transport of the hazardous material described herein, provided that maximum tested weights and quantities are not exceeded and the packaging is assembled as tested. The use of other packaging methods or components may make this test invalid.

PREPARED BY:  DATE: 1 Nov 2001
JEFFERY L. DUGAN
Test Engineer

SUBMITTED BY:  DATE: 1 Nov 2001
JERRY W. BEAVER
Chief, Validation Engineering Division

APPROVED BY:  DATE: 1 Nov 2001
WILLIAM R. FRERICHS
Associate Director for Engineering

PART 5 – SPECIAL PACKAGING INSTRUCTIONS

SPECIAL PACKAGING INSTRUCTION					Form Approved OMB No. 0704-0188
1. PART OR DRAWING NO. NOMENCLATURE N/A * LIGHT BOX PROCEDURES-MIL-B-2427			2. CODE IDENT 59678		3. SPI NO. ADPLBOX001
4. NATIONAL STOCK NO. N/A *			5. DATE OF SPI (YYMMDD) 010709		6. REVISION A
7. QUANTITY OF ISSUE VARIOUS*	8. ICQ —	9. UNIT PACK WT (lb) (0.0) 145.0 MAX	10. UNIT PACK CU (C.U.F.) 3.200 MAX		11. UNIT PACK SIZE (INCHES) L<45" L+W+H< 70"
			18. STEPS	19. REQD	20. DESCRIPTION
12. MILITARY PRESERVATION MIL-STD-2073-1			1	AR	FILLER, ASTM D4727, SF OR CR, SEE NOTE F
			2	AR	CUSHIONING, SEE NOTE F
13. CLEANING N/A			3	1	WOOD BOX, MIL-B-2427, TY I OR II, CLASS 1 OR 2 SEE NOTES A AND C
			4	AR	CLOSURE, MIL-B-2427, APPENDIX
14. DRYING N/A					
15. PACKING MIL-STD-2073-1					
a. LEVEL A N/A					
b. LEVEL B N/A					
16. MARKING 8796522					
17. NOTES/DRAWING *THESE BLOCKS WILL VARY DEPENDING UPON ITEMS BEING PACKED.					
A. THIS DOCUMENT CONTAINS INSTRUCTIONS FOR THE PREPARATION OF LIGHT BOXES WEIGHING NOT MORE THAN 145 LBS. BUT WITH A TOTAL CUBE OF 3.200 CUBIC FEET OR LESS. THIS SPI IS DESIGNED TO UTILIZE EXISTING MIL-B-2427 WOODEN BOXES IN THE INVENTORY THAT MEET THE REQUIREMENTS IN STEP 3 AND APPLIES TO ANY NSN THAT MEETS THE REQUIREMENTS OF NOTE C. CONTAINERS THAT MEET THE REQUIREMENTS OF STEP 3 BUT ARE OF A SMALLER CUBE OR SIZE THAN SPECIFIED IN BLOCKS 10 AND 11, MAY ALSO BE UTILIZED IN ACCORDANCE WITH THIS SPECIAL PACKAGING INSTRUCTION.					
B. THE LIGHT BOX MARKING REQUIREMENT OF 8796522 APPLIES TO THIS PACKAGE.					
C. REQUIREMENTS FOR USE OF THE CONTAINER IN STEP 3 FOR LIGHT PACKS:					
1. THE QUANTITY BEING PACKAGED IS LESS THAN THE FULL STANDARD PACK QUANTITY.					
2. APPROVED INNER PACK CONFIGURATION (i.e. CARTONS, FIBER TUBES, METAL CONTAINERS (M2A1, M19A1 etc.)) ARE NOT CHANGED FROM THE ORIGINAL PACK, EXCEPT FOR ADDITIONAL CUSHIONING AND/OR FILLER NEEDED TO OBTAIN A TIGHT PACK.					
3. AS AN ALTERNATIVE TO THE ORIGINAL EXTERIOR BOX FOR EITHER PPP-B-585, ASTM D6251/D 6251M, PPP-B-621, MIL-B-2427, MIL-B-46506 OR MIL-B-48024.					
4. IF A COMPETENT AUTHORITY APPROVAL (CAA) IS REQUIRED FOR THE ITEM BEING SHIPPED, IT MUST MEET THE PACKAGING REQUIREMENTS SPECIFIED ON THE CAA.					
D. THE PROPER SHIPPING NAME AND IDENTIFICATION NUMBER SHALL BE AS SPECIFIED BY UN NUMBER LISTED IN THE JOINT HAZARD CLASSIFICATION SYSTEM OR A CURRENT INTERIM HAZARD CLASSIFICATION FOR NSN BEING PACKED.					
E. THE POP MARKING FOR THE CONTAINER IS AS FOLLOWS:  4C1/Y66S/(YEAR PACKED) USA/DOD/AYA					
F. FILLER OR CUSHIONING MATERIAL (A-A-59135, A-A-59136, ASTM D4727, A-A-1898, PPP-C-1797) SHALL BE USED TO OBTAIN A TIGHT PACK.					
WSC:	ITEM SIZE:	ITEM WEIGHT:	APPROVED: <i>W. Kimberley Wheat</i>		
STATEMENT A, UNLIMITED					
DD Form 2169, Oct 96 Previous editions are obsolete Page 1 of 1 Pages					

PART 6 - DRAWING

The following drawings represent the Box, Wooden for Howitzer Ammunition
in a Fiber Container, M105A3, Drawing No. 7549072.

OTES:

- A-INDICATES STEEL CASE.
 B-INDICATES STEEL CASE, SPIRAL WRAPPED.
 C-INDICATES COMP B BURSTING CHARGE.
 D-NO REFERENCE LETTER ADJACENT FOR INDICATES BRASS CASE.
 E-AMMUNITION FOR CANNON WITH GAS PROPELLETS.

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